



Argonne
NATIONAL
LABORATORY

... for a brighter future

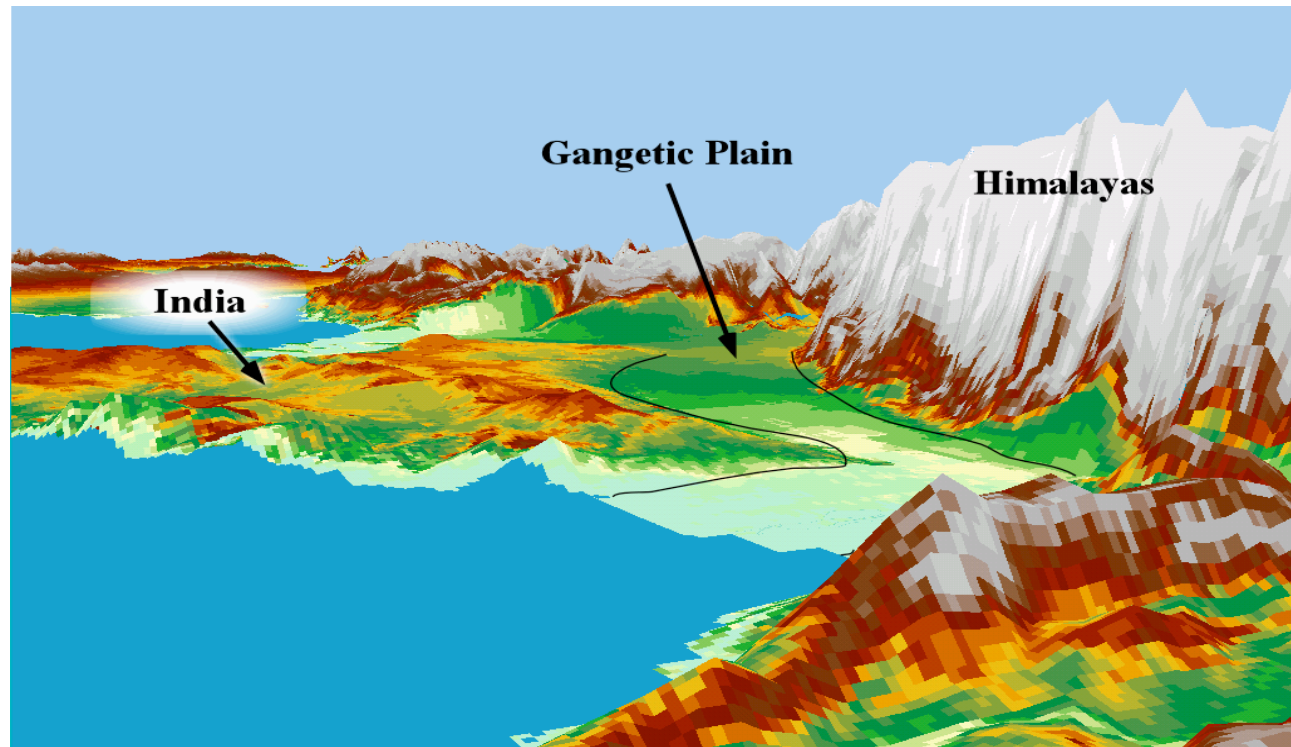


U.S. Department
of Energy

UChicago ►
Argonne LLC

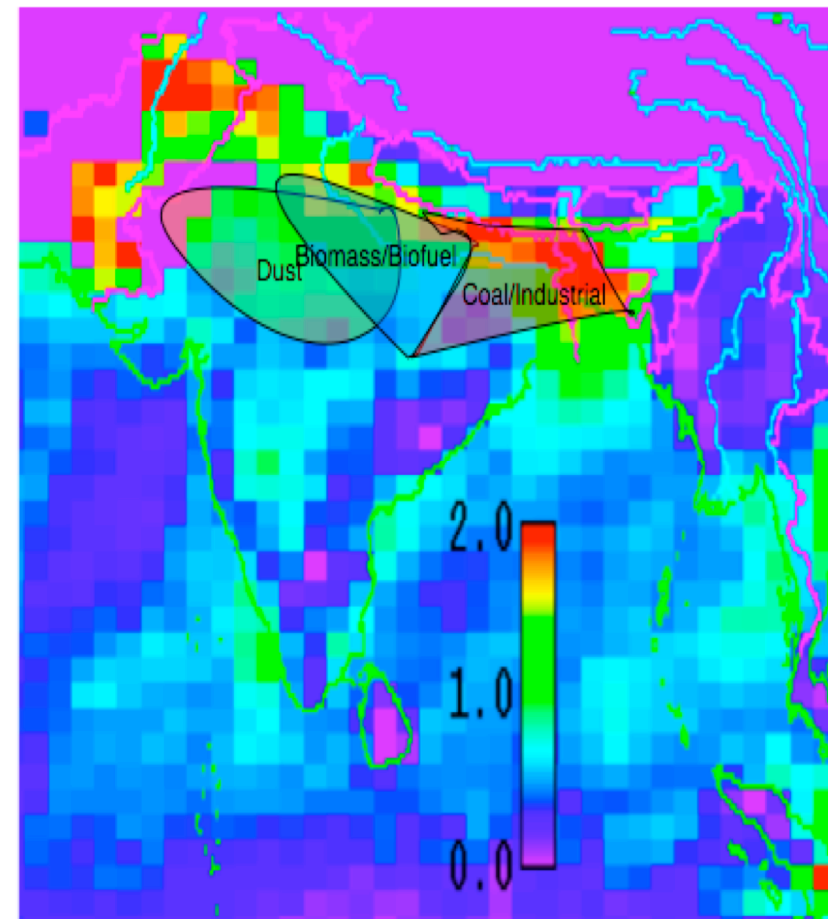
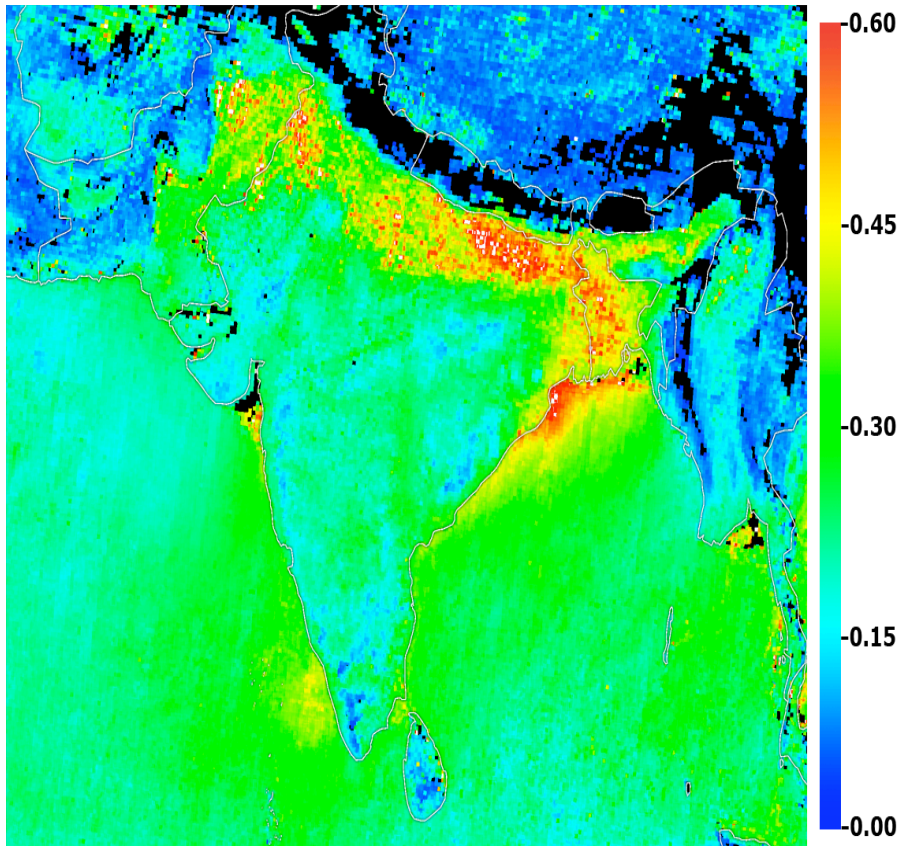
A U.S. Department of Energy laboratory
managed by UChicago Argonne, LLC

GVAX – A Field Campaign to Characterize Aerosols and Their Regional Extent

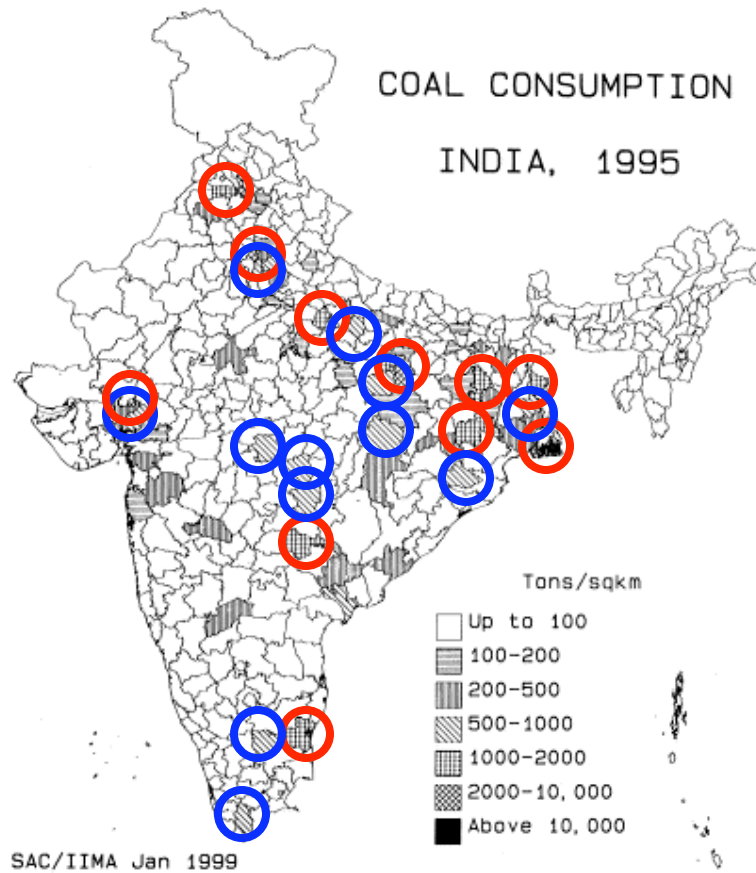


V. Rao Kotamarthi

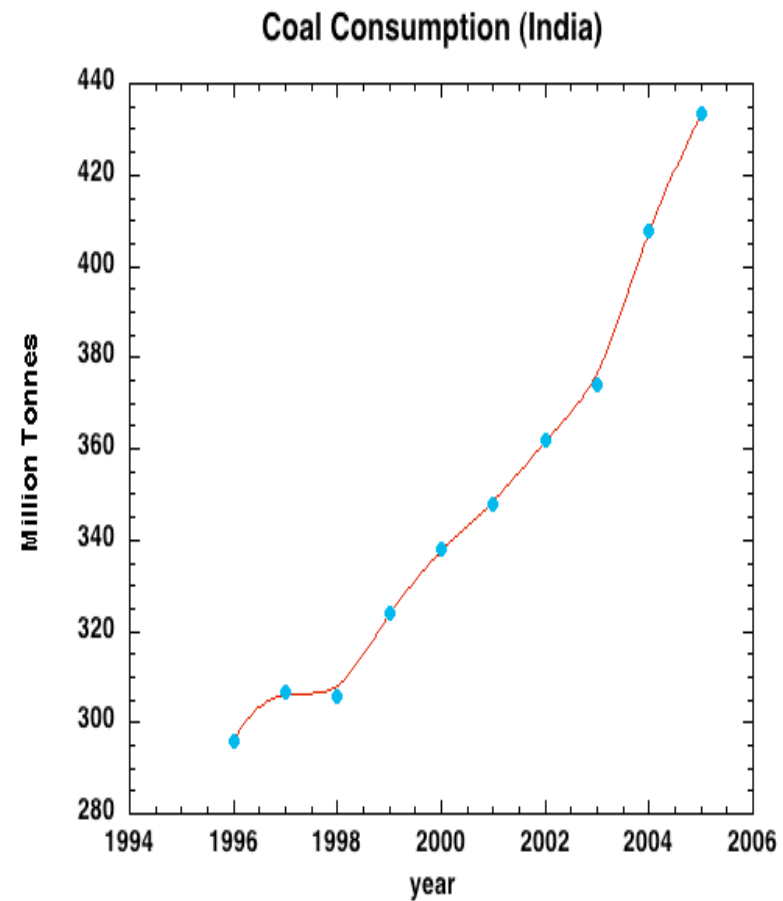
Motivation



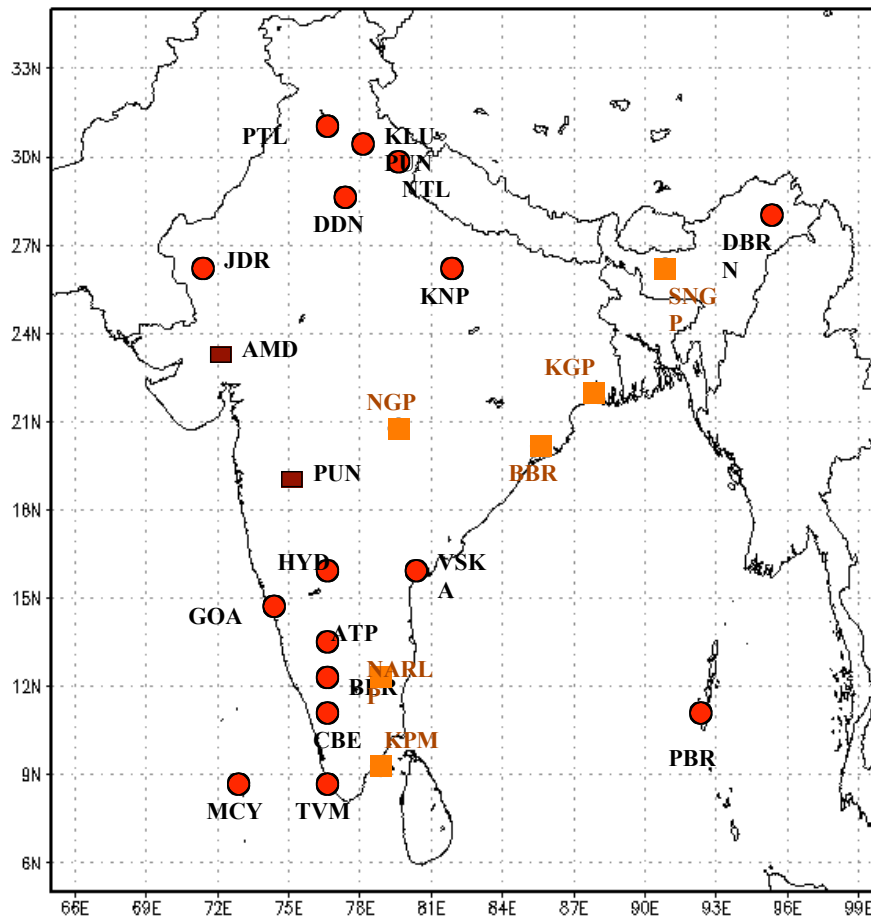
MISR 558 nm AOD Averaged Over
DJF 2001, 2002, 2003, 2004



- > 1000 tons/sqkm
- 500 - 1000 tons sqkm



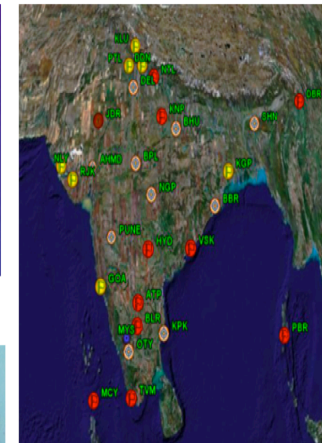
Existing Measurement Network



Geophysica



Pavan Hansa
(trainer)



ISRO Network Observatories
(29 sites)



ISRO Aircraft



R/V Sagar Nidhi



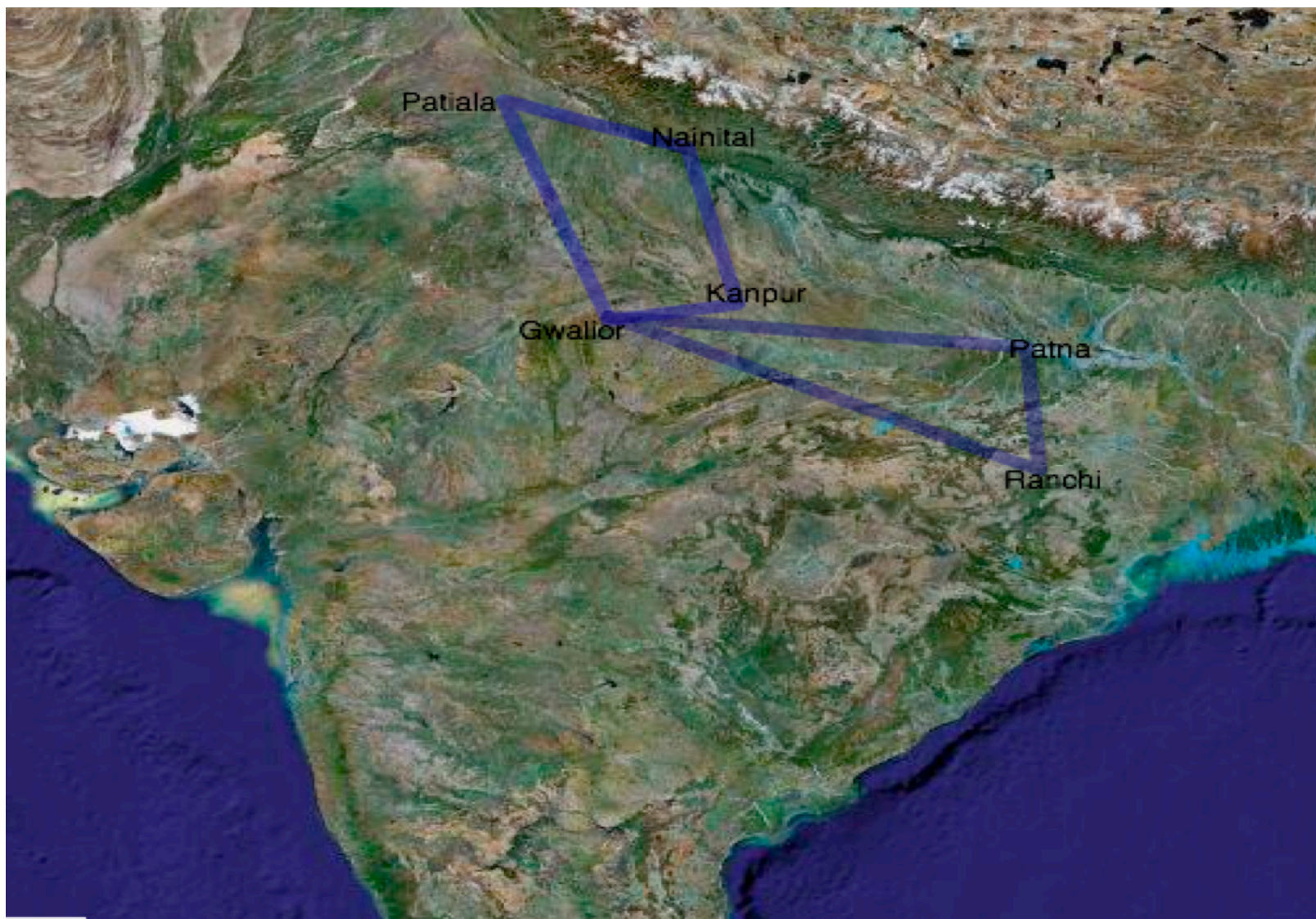
R/V Sagar Kanya

- 5000 rain gauges
- Several satellites (METEOSAT, MODIS, MISR and so on.)

Objectives

- ❑ Measure the fraction of secondary organic aerosols, which emission profiles in India suggest are likely a significant portion of the measured aerosol mass.
- ❑ Exploit a unique opportunity to add to the correlation between CO and BC observed in previous ASP studies.
- ❑ Measure sulfate aerosol generated by numerous coal-fired power plants operating with high-sulfur coal. Further elucidate the formation of sulfate aerosols under a climate regime very different from those addressed in previous ASP studies.
- ❑ Generate data for developing better estimates of future sulfate aerosol burden in the Ganges valley and the rest of Asia, for IPCC scenario development.
- ❑ Measure fluxes of aerosols transported out over to the Indian Ocean. Estimate their large-scale impact.
- ❑ Measure PBL evolution and associated heat and moisture fluxes as a function of time of day and season. Use measured PBL heights to estimate the fraction of aerosols in the column *within* the PBL, as compared to above it. The fraction of aerosols above the PBL can have regional and global-scale impacts.
- ❑ During the early spring period, which is marked by increased convective activity and clouds, evaluate the compositions of mid tropospheric aerosols and their contributions to local heating rates, in order to test current theories on the effects of aerosols on monsoon and cloud-aerosol interactions in the Ganges valley.

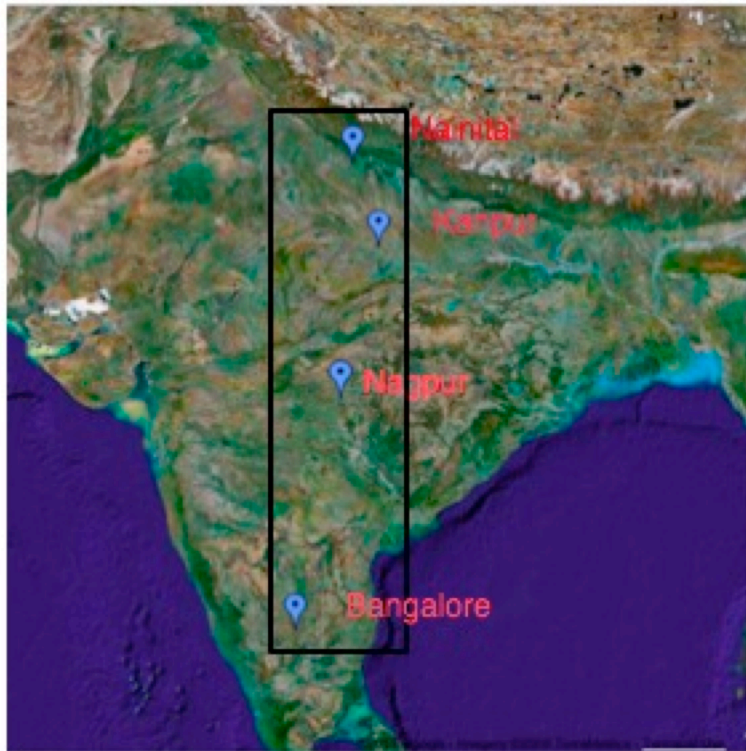
Potential Flight Plans



Surface Sites



AMF Deployment Proposal (Nagpur)



Planning Activities

- Visited Banagaluru, India, November 2008.
- A group of collaborators from IISc and Indian Space Research Institute (ISRO) were present for the discussion. Those present included:
 - Prof S. K. Satheesh, Associate Professor, Center for Atmospheric and Oceanic Research, Indian Institute of Science, Banagaluru.
 - Dr. K. Krishnamoorthy, Scientist G, Space Research Laboratory (SPL), Vikram Sarabhai Space Center (VSSC), Thiruvanthapuram, Kerala, India and lead scientist for the Geosphere Biosphere Program (GBP).
 - Dr. CBS Dutt, Deputy Program Director, ISRO-GBP and Member-Secretary, JSWG-MT-ISRO, ISRO Headquarters, Bangaluru, India.
 - Prof. Ram Sagar, Director, Aryabhata Research Institute of Observational Sciences (ARIES), Manora Peak, Nainital, India
 - Prof. G. S. Bhatt, Chairman, Center for Atmospheric and Oceanic Sciences (CAOS), Indian Institute of Science, Bangaluru, India.
 - Dr. K. J. Ramesh, Advisor/Scientist G, Ministry of Earth Sciences, New Delhi, India (on phone).

Planning Activities

- The Indian scientists (Dr. Krishnamoorthy) described a proposed field study for 2009 to investigate cloud –aerosol interactions. The study named Cloud Aerosol Interaction & Precipitation Enhancement Experiment (CAIPEEX) is expected to use a leased NCAR C-130 platform for evaluating monsoon clouds and aerosol interactions.
- Dr. CBS Dutt also expressed considerable interest in ASP capability for measuring atmospheric gas phase pollutants and ozone and its precursors in particular. We discussed the instrumentation available onboard G-1 for measuring trace gases and potential benefits to the Indian science in this area.
- Dr. Ram Sagar, the director of ARIES, located at Nainital gave an excellent description of the site. Nainital is in the foot hills of the Himalayas and ARIES is primarily an astronomical observatory at an elevation of about 2km above the sea level. The area below this site is all covered with pine vegetation throughout the year and a rich source of isoprene in addition to all the aerosol emissions in the valley below. Every day the aerosol plume can be seen below this station and rises up to the lower levels by noon and mixes with the clouds.
- We also discussed the potential for Indian agencies providing additional supporting measurements. It was suggested that ship-based platform is available and can be used for the study.

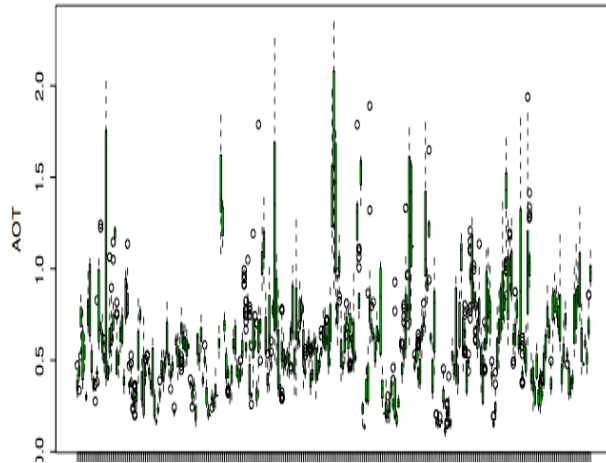
Planning Activities

- Surface stations will also work in a cooperative mode during the mission to collect relevant aerosol and data collected will be shared. The Indian scientists also expressed significant interest in using the ASP field study to validate data collection and retrievals from satellite based platforms such as OMI, MODIS and CALIPSO.
- Data sharing protocol was also discussed. I mentioned that ASP has a 6 month embargo on data and then it is released to the wider public. The Indian scientists have no formal procedures but have used a 1-year embargo to give participating scientists enough time to analyze the data sets before public release. In general it seemed reasonable that a compromise could be reached that would be more in tune with ASP requirements if adequate software for publishing the data in ASP format is made available to the Indian scientists.

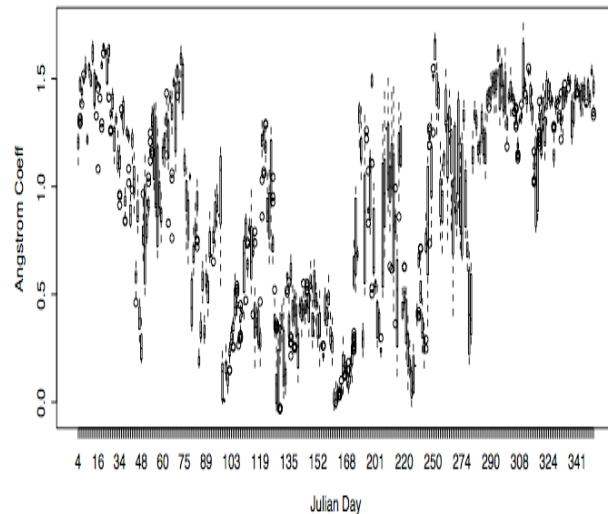


Motivation

Kanpur AERONET data at 500 nm 2005

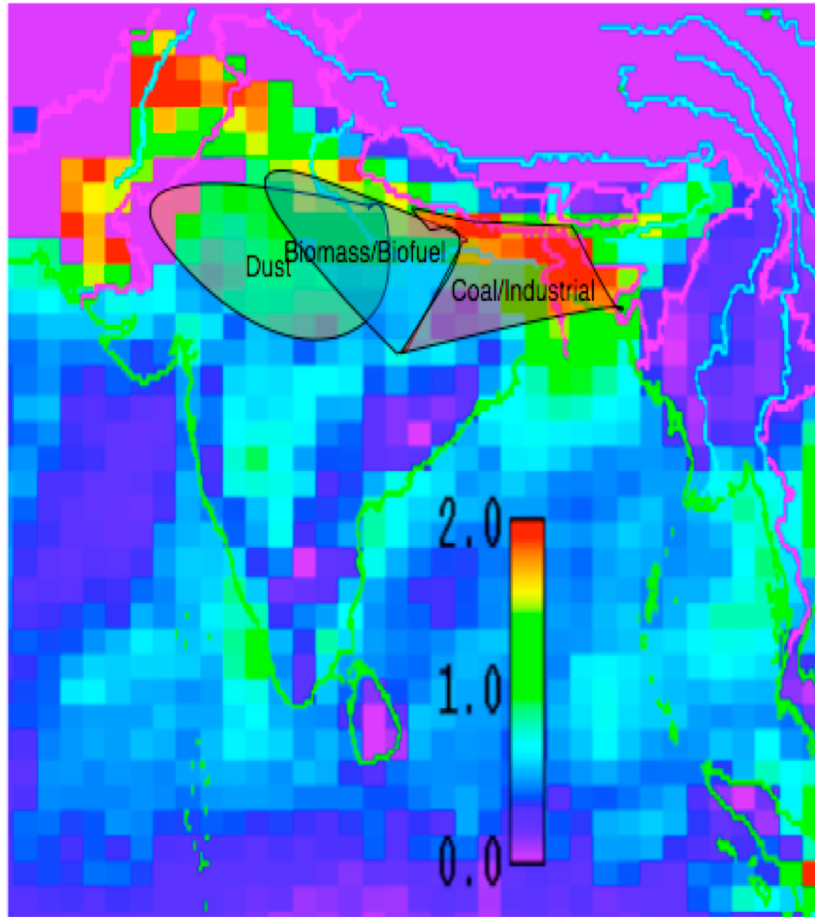


Angstrom Coeff for 2005, 440-870



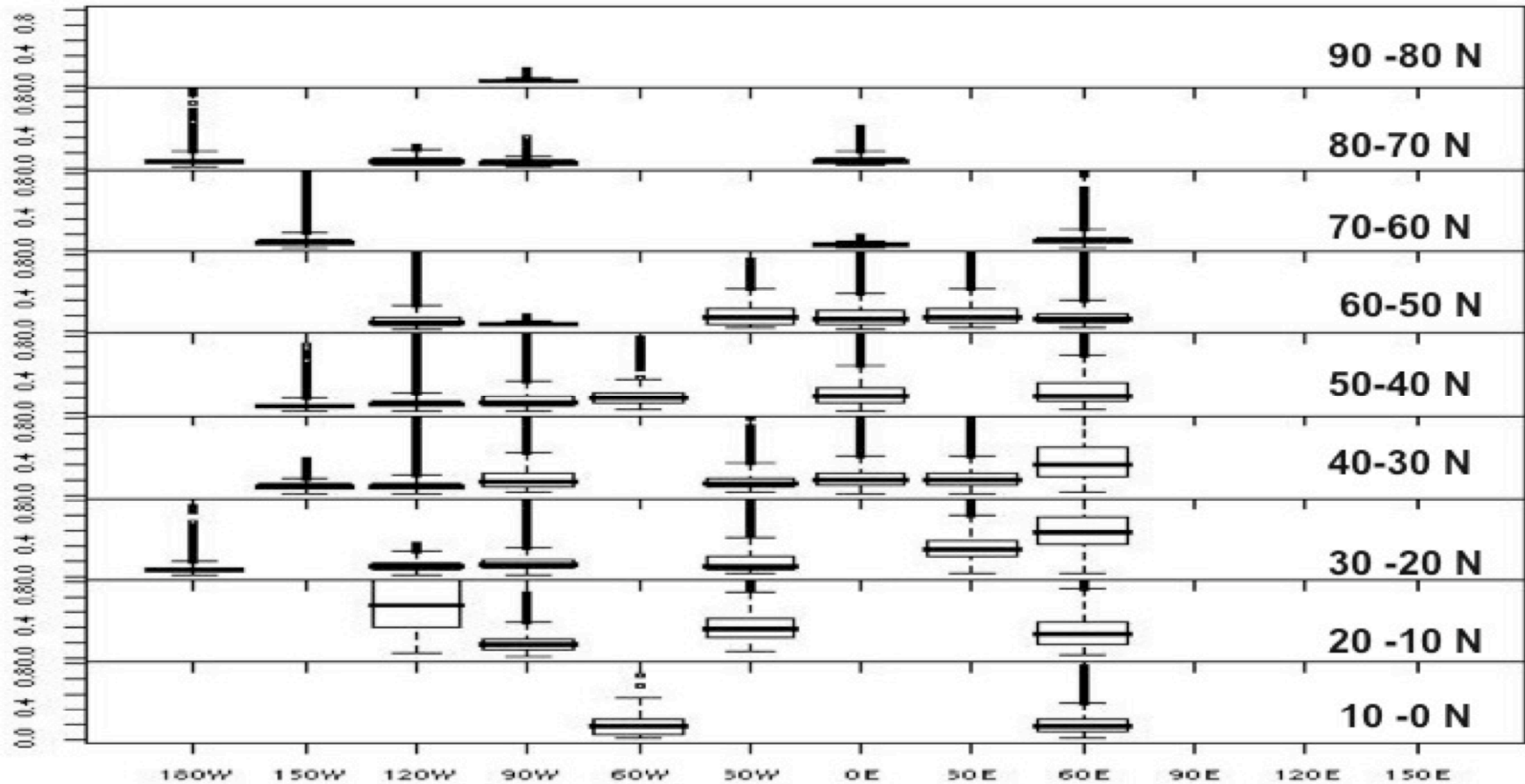
- There has been no comprehensive study to understand the source, chemistry and transport of these aerosols over the subcontinent of India.
- The longrange viability of the plume is very dependent on the vertical structure of the the aerosol cloud, there is absolutely no significant information on this aspect.
- The complex terrain of this region suggests significant impact of mesoscale flow in affecting the distribution of aerosols. There are no intensive measurements of flow fields during these aerosol episodes.
- There have been several recent publications comparing the MISR data sets with AERONET data collected at Kanpur, india. The correlation was shown to be reasonable.
- There are no surface stations in the region where the highest AOD's were noted by DiGirolamo. A new AERONOT station has started operating this year in that region.

Motivation



- The remote sensing instruments, such as the HSRL, CALIPSO (lidar) and the MISR are in need of ground validation for this part of the world.
- Improved profile and source signatures could lead to better retrieval of aerosol optical depths from remote sensing.
- The region is marked by low valley and fog is a dominant part of the winter time climate. Aerosol generation and its lifetime in a fog dominated environment is a unique feature of this valley.
- NCEP data shows very light winds during the high AOD episodes in this region. However very little is known about the potential mountain-valley circulations and its effect on generating and dissipating these event.

Motivation



AERONET AOD measurements. The ordinate shows longitude bins of 30 deg going from 180 W to 180 E. The y-axis shows AOD for each 10-deg latitude band, going from the equator to 90 N. The longitude bands are 30 deg wide, starting at the longitude shown on the x-axis and stretching to the next listed longitude.